CLAIMS

2. A security document comprising a substrate including at least one layer of polymeric material and containing an upconverting fluorescent material, and at least one coating containing a refractive pigment applied to the substrate, wherein when the security document is exposed to electromagnetic radiation of a particular wavelength the upconverting material emits a signal of electromagnetic radiation of a shorter wavelength and the coating containing the refractive pigment enhances the signal emitted by the upconverting material.

3. A security document as claimed in claim 1 wherein the substrate includes a polymeric base layer.

4. A security document as claimed in claim 2 wherein the base layer is formed from a transparent polymeric material.

5. A security document as claimed in claim 1 wherein the substrate includes a base layer of paper or fibrous material.

6. A security document as claimed in any one of claims 2 to 4 wherein the substrate includes one or more layers of polymeric material provided on a base layer.

7. A security document as claimed in any one of claims 2 to 5 wherein the upconverting material is dispersed in the base layer.

8. A security document as claimed in claim 5 wherein the upconverting material is dispersed in the at least one layer of polymeric material provided on the base layer.

9. A security document as claimed in any one of the preceding claims wherein the coating containing the refractive pigment is in intimate contact with the at least one polymeric layer containing the upconverting material.

10. A security document as claimed in any one of the preceding claims wherein the coating containing the refractive pigment is a highly refractive opacifying coating.

11. A security document as claimed in claim 9 wherein the opacifying coating comprises at least one refractive pigment dispersed in a polymeric or resin binder.

12. A security document as claimed in claim 10 wherein the at least one refractive pigment is selected from the group including titanium dioxide, calcium carbonate, barium sulphate and zinc oxide.

13. A security document as claimed in claim 11 wherein the binder is a cross-linked polymeric material.

14. A security document as claimed in claim 11 or claim 12 wherein the binder is selected from the group including acrylics, polyester and polyurethane.

15. A security document as claimed in any one of claims 11 to 13 wherein the refractive pigment and the binder are substantially transparent to the excitation wavelengths used to excite the upconverting material.

16. A security document as claimed in claim 14 wherein the refractive index of the pigment is larger than the refractive index of the substrate.

17. A security document as claimed in claim 14 or claim 15 wherein the refractive index of the pigment is larger than the refractive index of the binder.

18. A security document as claimed in claim 15 or claim 16, wherein the refractive index of the pigment is at least 0.3 greater than the refractive index of either the substrate or the binder.

19. A security document as claimed in any one of the preceding claims wherein the substrate containing the upconverting fluorescent material is a

transparent substrate and the coating containing the refractive pigment is an opacifying coating which is applied only partly over the transparent substrate to form a window on at least one side of the security document which is not covered by the opacifying coating.

20. A security document as claimed in claim 18 wherein the opacifying coating is applied only partly on one side of the substrate, and the opacifying coating is applied to cover the entire surface of the polymeric layer on the opposite side of the substrate.

21. A security document as claimed in claim 18 or claim 19 wherein the signal emitted from parts of the substrate covered by the opacifying coating is stronger than the signal emitted from parts of the substrate which are uncovered by the opacifying coating.

22. A security document as claimed in any one of the preceding claims wherein the upconverting material is uniformly dispersed in the polymeric material.

23. A security document as claimed in any one of the preceding claims wherein the concentration of upconverting material is not more than about 1% by weight of the polymeric material.

24. A security document as claimed in claim 22 wherein the concentration of upconverting material is substantially within the range from about 0.0025% to about 0.25% by weight of the polymeric material.

25. A method of manufacturing a security document including : providing a substrate having at least one layer of polymeric material; incorporating at least one upconverting fluorescent material in the at least one layer of polymeric material; and applying a refractive coating to at least one surface of the substrate.

26. A method as claimed in claim 24 wherein the upconverting material is incorporated into the at least one layer of polymeric material in an extrusion process.

27. A method as claimed in claim 25 wherein in the extrusion process, the upconverting material is mixed uniformly with the co-extruded polymeric material as it passes through the extruder and dies.

28. A method as claimed in claim 26 wherein the upconverting material is mixed with the polymeric material, in an extruder barrel, at an elevated temperature.

29. A method as claimed in any one of claims 24 to 27 wherein the concentration of the upconverting material is not more than about 1% by weight of the polymeric material.

30. A method as claimed in claim 28 wherein the concentration of upconverting material falls substantially within the range from about 0.0025% to about 0.25% by weight of the polymeric material.

31. A method as claimed in any one of claims 24 to 29 wherein the refractive coating contains at least one refractive pigment which enhances signals emitted from the fluorescent upconverting material when the security document is exposed to electromagnetic radiation of a particular wavelength.

32. A method as claimed in claim 30 wherein the at least one refractive pigment is dispersed in a polymeric or resin binder.

33. A method as claimed in claim 30 or claim 31 wherein the at least one refractive pigment is selected from the group including titanium dioxide, calcium carbonate, barium sulphate and zinc oxide.

34. A method of verifying the authenticity of a security document including:

providing a substrate including at least one polymeric layer containing an upconverting fluorescent material;

providing the substrate with at least one opacifying coating containing a refractive pigment;

exposing the upconverting material to electromagnetic radiation of a selected wavelength to excite the upconverting material; and

detecting a signal of electromagnetic radiation emitted from the excited upconverting material at a shorter wavelength than the wavelength selected to excite the upconverting material.

35. A method as claimed in claim 33 wherein the electromagnetic radiation selected to excite the upconverting material is infra red radiation, and the signal of electromagnetic radiation emitted from the upconverting material falls within the visible spectrum.

36. A method as claimed in claim 33 or claim 34 wherein the at least one opacifying coating only partly covers the substrate, and different signals emitted from the covered and uncovered parts of the substrate are analysed to authenticate the security document.

AMENDED CLAIMS
[received by the International Bureau on 07 February 2005 (07.02.05);
claims 24, 30-35 amended, claims 36-39 added, remaining claims unchanged (4 pages)]

transparent substrate and the coating containing the refractive pigment is an opacifying coating which is applied only partly over the transparent substrate to form a window on at least one side of the security document which is not covered by the opacifying coating.

19. A security document as claimed in claim 18 wherein the opacifying coating is applied only partly on one side of the substrate, and the opacifying coating is applied to cover the entire surface of the polymeric layer on the opposite side of the substrate.

20. A security document as claimed in claim 18 or claim 19 wherein the signal emitted from parts of the substrate covered by the opacifying coating is stronger than the signal emitted from parts of the substrate which are uncovered by the opacifying coating.

21. A security document as claimed in any one of the preceding claims wherein the upconverting material is uniformly dispersed in the polymeric material.

22. A security document as claimed in any one of the preceding claims wherein the concentration of upconverting material is not more than about 1% by weight of the polymeric material.

23. A security document as claimed in claim 22 wherein the concentration of upconverting material is substantially within the range from about 0.0025% to bout 0.25% by weight of the polymeric material.

24. A method of manufacturing a security document including: providing a substrate having at least one layer of polymeric material; incorporating at least one upconverting fluorescent material in the at least one layer of polymeric material; and applying a refractive coating to at least one surface of the substrate, wherein the refractive coating contains at least one refractive pigment which enhances signals emitted from the fluorescent upconverting material when the

security document is exposed to electromagnetic radiation of a particular wavelength.

25. A method as claimed in claim 24 wherein the upconverting material is incorporated into the at least one layer of polymeric material in an extrusion process.

26. A method as claimed in claim 25 wherein in the extrusion process, the upconverting material is mixed uniformly with the co-extruded polymeric material as it passes through the extruder and dies.

27. A method as claimed in claim 26 wherein the upconverting material is mixed with the polymeric material, in an extruder barrel, at an elevated temperature.

28. A method as claimed in any one of claims 24 to 27 wherein the concentration of the upconverting material is not more than about 1% by weight of the polymeric material.

29. A method as claimed in claim 28 wherein the concentration of upconverting material falls substantially within the range from about 0.0025% to about 0.25% by weight of the polymeric material.

30. A method as claimed in any one of claims 24 to 29 wherein the at least one refractive pigment is dispersed in a polymeric or resin binder.

31. A method as claimed in any one of claims 24 to 30 wherein the at least one refractive pigment is selected from the group including titanium dioxide, calcium carbonate, barium sulphate and zinc oxide.

32. A method of verifying the authenticity of a security document including:

providing a substrate including at least one polymeric layer containing an upconverting fluorescent material;

providing the substrate with at least one opacifying coating containing a refractive pigment;

exposing the upconverting material to electromagnetic radiation of a selected wavelength to excite the upconverting material; and

detecting a signal of electromagnetic radiation emitted from the excited upconverting material at a shorter wavelength than the wavelength selected to excite the upconverting material.

33. A method as claimed in claim 32 wherein the electromagnetic radiation selected to excite the upconverting material is infra red radiation, and the signal of electromagnetic radiation emitted from the upconverting material falls within the visible spectrum.

34. A method as claimed in claim 32 or claim 33 wherein the at least one opacifying coating only partly covers the substrate, and different signals emitted from the covered and uncovered parts of the substrate are analysed to authenticate the security document.

35. A method of manufacturing a security document including : providing a substrate having at least one layer of polymeric material; incorporating at least one upconverting fluorescent material in the at least one layer of polymeric material by an extrusion process; and applying a refractive coating to at least one surface of the substrate.

36. A method as claimed in claim 35 wherein in the extrusion process, the upconverting material is mixed uniformly with the co-extruded polymeric material as it passes through the extruder and dies.

37. A method as claimed in claim 36 wherein the upconverting material is mixed with a polymeric material, in an extruder barrel, at an elevated temperature.

38. A method as claimed in any one of claims 35 to 37 wherein the concentration of the upconverting material is not more than about 1% by weight of the polymeric material.

39. A method as claimed in claim 38 wherein the concentration of upconverting material falls substantially within the range from about 0.0025% to about 0.25% by weight of the polymeric material.